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ABSTRACT

This paper outlines an evaluation system for elementary education based on cognitive and social development research. Piaget has defined certain core mental structures that develop in all humans in the same order. Both Piaget and Kohlberg have done work on the process of developmental change and the conditions necessary for optimal growth of the reasoning structure. From this work several objectives -- the determining of developmental stages, the facilitating of developmental growth, and the use of this information to enhance educational process -- are proposed for a cognitive-developmental evaluation system. Steps proposed include the specification of outcome objectives, the measurement of student performance based on developmental levels, and the observation and measurement of process objectives, that is, objectives that provide the opportunity for natural development to take place in the classroom. In an appendix sample tasks on conservation and logical relations are provided to typify the first steps and 81 process objectives with directions for using them in the classroom are provided for the last. Next, fitting other educational objectives in this cognitive developmental system and use of the evaluation by educators are discussed. Areas of needed research and of research under way are suggested as well a specific plan to test the measurement steps. (JH)

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Education for Development:

An Evaluation System

Piagetian Theory Applied to the Evaluation of Educational Outcomes and Processes

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I. Introduction

This paper outlines an evaluation system for elementary education which is based on the cognitive and social development of children. It is a direct application of theory and research in cognitive-developmental psychology to the schoolong process. It assumes that the development of reasoning structures - physical, logical, social, moral - in the child's mind is the main aim of education. The system is intended to measure how well an educational program is fostering the development of these structures in its children.

Important to this system are the theory and research of Jean Piaget and his followers, which for the last fifty years have explained and investigated the nature of individual cognitive development, its sequences, structures, and processes.(1) This work has defined certain mental structures or ways of reasoning, which develop in all humans in the same order. These "core" structures are the thinking processes which are common to all mental activity and applicable to many specific content areas. As such, they are independent of cultural milieu, specific training, contemporary fads, personality type, and social class. They should be immune to future shock and changes in values or work; they are stable and cannot be unlearned. (2)

Piaget has carefully described the logical structure of each of the stages of cognitive growth he has observed, and has suggested methods for ascertaining children's stage-structures in several cognitive areas. Lawrence Kohlberg has followed Piaget's lead in the area of social and moral development, outlining a detailed sequence of stages and a clear assessment methodology. Both have also done work on the process of developmental change andthe conditions or atmospheres necessary for the optimal growth of the reasoning structures. (3)

The system of evaluation described below applies this work to student learning and the schooling process. The first section of the paper deals with the specification of outcome objectives and the measurement of student performance. Next, process objectives are specified which describe a learning environment which should lead to optimal development in cognitive and moral domains. The last sections of the paper deal with how other educational ob-

jectives may fit into this system, how the evaluation information may be used by the educator, and some areas of research involving this system. Appendices include some examples of developmental scales, assessment tasks, normative data, classroom rating scales, and a description of the work which produced the rating scale.

II. Outcome Objectives

From Goals to Objectives

An evaluation system must begin with a statement of general goals for education. The development of core structures of thinking, of those mental processes which are common to all humans and applicable to most fields of study and work, is the general aim of education in this system. This goal may be further defined by a detailed description of these structures in two broad related areas, cognitive development and moral development. Piaget and his followers, through careful observation and experimentation, have described the sequence of cognitive structures as they occur in the course of human development. Piaget's findings would require many volumes to compile, or even summarize effectively. (4) The concern here is with those findings which give a general picture of development and are especially amenable to use in educational evaluation.

Piaget is a genetic epistemologist by self-description. He is interested in the growth of ways of knowing in humans. He has found that the ways of knowing for children are different from those for adults, and that the different ways of knowing follow a universal sequence, one after the other, as the human organism develops. Each way of knowing is also a logical system, a structure of thinking, which is organized in a particular way. Piaget has posited stages of cognitive growth, each stage being a way of knowing the world, later stages being more adequate ways of knowing than earlier stages. Within each stage, the core structure is applied to different areas of knowledge. Careful study has been done on how the thinking structures at each stage are applied to concepts of quantity, logic, number, time, movement, causality, space, chance, and others. (5) Concepts of morality and social judgment have been studied by Kohlberg, who has described stages

of moral reasoning which are based on Piagetian cognitive stages. (6)

The goal for this system is optimal movement through this sequence of developmental stages by each child, and the widening application of his reasoning structure to the many areas of knowledge. There is an objective of vertical growth: the development of higher stages of reasoning; and an objective of horizontal growth: the application of a stage to various content areas. If the sequence of vertical growth and the possible areas of horizontal application are clearly specified, then the objectives for each child are evident. Once his current stage is known, the objectives are:(7)

1. To apply the structure of his present stage to as many areas as possible, and
2. To reach the next stage in the sequence.

This evaluation system cannot measure every child in every possible area of mental functioning. A complete description of the sequence of thinking structures in every area of knowledge is not the task at hand. This work is being done by Piaget and his followers as reported in their "experimental" books. (8) The purpose of this system is to specify methods by which the naturally developing core structures may be assessed through several representative areas of knowledge. These areas and methods have been chosen because of their ease of assessment and their history of common usage.

The sequence of core structures, Piaget's stages of cognitive growth, are briefly described in Appendix A, along with Kohlberg's stages of moral development. These are descriptions of ways of thinking characteristic of each stage-structure, with examples of applications to content in some knowledge areas.

The behavioral performance which is evidence of the attainment of a particular stage is the subject of the next section of this paper, and is specified in the tasks which are the instruments of individual measurement in this system.

Measuring Children's Performance

The objectives in this system are the development and use of reasoning structures in the child's mind. These structures must be assessed in order to measure individual attainment of objectives.

A mental structure as such cannot be observed or measured directly; it must be inferred from behavior. The tasks which have been chosen as measurement instruments allow for the accurate inference of structure from the behavior used in performing the task. They are modeled after the experiments which were originally used to research the nature of cognitive and moral structures. A certain kind of performance on a task is evidence of a certain underlying mental structure.

Several research teams are standardizing these Piagetian tasks and collecting normative and reliability data on them. Vinh-Bang in Geneva, and Pinard in Montreal, are organizing these tasks into complete systems of cognitive assessment. (9) Until their results from years of study on thousands of children are published in final form, this evaluation system will have to rely on tasks which are not so well standardized or systematized. But they should do just as well in assessing a child's mental structure in terms of an absolute standard of developmental sequence, which is the criterion of reference in this system. True normative data and reliable statistics will have to wait for more complete scales and tests, but the measurement of the objectives of this system can adequately be done with the available tasks.

Appendix B lists some selected Piagetian tasks, with brief administration instructions and performance-structure explanations. These and other tasks may be used in assessment in two general ways. Direct, individual "clinical" procedures may be used, taking individual children alone, administering one or several tasks, and observing and recording their performance. Or, the equipment for the tasks may be available in the classroom, and a more naturalistic assessment technique may be used. Children may be questioned and directed in assessment tasks in their everyday work with the equipment and materials at hand. For either method, but especially with the informal one, careful records must be kept of individual performances.

The use of these tasks requires considerable theoretical knowledge on the part of the tester in order for him to accurately infer cognitive structure from a child's performance. With some experiential training in the classroom, the teacher should be able

to administer the tasks. Reading or instruction in the theory of structural-cognitive development is necessary to use the tasks properly in evaluation.

For the children to be tested, familiarity with the equipment and materials used in the tasks is important. Most of them can be made available in the classroom for everyday use. The use of familiar things in the tasks will give a truer picture of the child's structure.

Even though data on norms has been sketchy so far, included in the appendix are some age-norms which have been gleaned from the experimental research literature where these tasks have been performed with children. Because of variations in equipment, testing procedure, and the criteria of the experimentors, these age-norms are rough averages and are subject to wide variation. They should <u>not</u> be used as guides to setting objectives for individual children. (11)

III. Process Objectives

According to Piaget, the growth of reasoning structures is a natural process, motivated by functional tendencies common to all organismic life: the tendency to organize experience and the tendency to adapt to the environment. Each reasoning structure is an organization of experience, which the human has constructed in order to adapt to his world. Higher stages are developed because they are better organized and more adapted to the experiences of the world. (12) The structures, in stages, are the natural result of the person's interaction with the environment. As such, development cannot be said to be "caused" by some instrumentality, which, when applied, leads to growth.

Theorists and researchers have, however, identified the mechanism of growth, the process of change from one stage to the next as it occurs naturally. It has been found that these processes cannot be forced to occur, that structural change cannot be caused by external treatments or training exercises unless the child is already at the very brink of structural change. (13)

An educational program, then, cannot be designed to cause structural change. But it can use the findings of research to provide opportunities for the natural processes to take place, and in fact encourage them. It can at least ensure that these developmental processes are not blocked while the child is in school; it can at most provide a structure through which development is kept track of, appropriate interactive experiences are engaged in, and the processes of growth are exercised.

The Classroom Process Objectives rating scale (Appendix E) lists the precise nature of such a "developmental" environment. It has been derived from theoretical explanations and empirical study of how development occurs, both vertical stage change and horizontal applications of structure. Appendix F details the evidence from which these objectives were derived. In general, the processes which are essential to cognitive growth and development may be outlined as follows.

I. Children interact with the content of the world.
   A. Engage in problem-solving activities.
   B. Explore and experiment with the environment.
   C. Perform actions with physical objects.

II. Children interact with their peers.
  A. Talk and listen to each other.
  B. Cooperate with groups in their activities.
III. Children experience "cognitive conflict."
  A. Are challenged in their thinking.
  B. Are aware of alternative methods of thinking.
  C. Discuss these methods with others.
IV. Teacher uses knowledge of developmental levels.
  A. Teacher is aware of children's thinking structures.
  B. Acitvities are geared to the child's level.
V. Children are motivated by the activities themselves.

The rating scale consists of several observable and measurable objectives for each process on this outline. A classroom which measures highly on this scale cannot be said to cause optimal growth; the growth is structured by the child's interaction with the environment. The classroom should, however, allow that interaction and foster particular kinds of interaction, or the growth will be hindered. This scale evaluated the classroom environment, its physical materials, the teacher's attitudes and actions, and the children's activities, in terms of cognitive- developmental theory and research. Its main function is to make educators aware of the specific processes which may be preventing the cognitive and social development of the children. It is not an attempt to outline a complete educational environment, curriculum content, or course of study. That must be left up to the teacher and the community. It is hoped that the implementation of their choice will not be in conflict with the processes necessary for development.

Instructions for the administration and scoring of the Classroom Process Objectives rating scale are included with it in the Appendix. The evaluation of processes is just as important as the evaluation of student performance in this system. As each of Piaget's stages is a way of knowing, the classroom processes described and measured by this instrument are a way of learning.

IV. Other Goals and Objectives

Because this is only an evaluation system, it does not specify what children should do all day in school. It does not specify what other goals besides the basic goal of optimal human development should be part of the educational program.

As long as the processes necessary for reaching the main goal are not precluded, other goals may be subsumed under it. The basic skill for life, thinking, is what the child should be learning to do in an educational program. The stages of growth of the structure of thinking in several parallel areas are the guides to the objectives and evaluations. Other kinds of thinking, and specific tools which may be used for thinking, should also be part of the learning which goes on in school. Traditionally, American schools have focused on two of these specific tools, symbolic language and computational mathematics, and have made them the basis of all education. The three R's have become known as skills, valuable in their own right, to be mastered at any cost. The system proposed in this paper considers reading, writing and arithmetic to be some of the specific tools for thinking, which are important for people in American society, but which are not necessarily developmental skills. A young child learns to think without reading, writing or adding. Deaf persons may reach Piaget's stage of formal operational thinking without ever hearing a bit of language. (14) There is no doubt that verbal interchange facilitates the development of thinking structures in children (15), but reading and arithmetic are not the uniquely necessary skills. Thinking is the skill; reading and math are some tools used by thinking as it deals with the world. (16)

So the basic subject of evaluation is the child's thinking, the development of his intelligence. This is the main criterion of growth in this system. Growth in other areas, such as reading, writing, math, history, painting, music, etc., will enhance the child's interaction with the environment and enable him to better deal with his world. Objectives and evaluations may be made for these tools as they are used by children, and their practice should be an integral part of any educational program. But they must not be put ahead of or displace the primary goals we have described.

First, activities used in the teaching and practice of these other areas must not be anti-developmental, or threatening to the further development of thinking. Especially, the processes used to teach them must not be antithetical to the processes necessary for general development. The Classroom Process Objectives rating scale

(Appendix E) may be used to assess the extent to which current teaching practices may be hindering children's development.

Second, the applications of these tools, especially reading and math, must fit in with the structures of thinking the children have at any given point. The objectives for reading and math performance must not be beyond the understanding possible with the current thinking structure of the child. Forcing growth in mechanical reading skill or arithmetic computation will not cause structural development in children's thinking. Rather, thinking structures must develop through other types of child-environment interactions (see rating scale), and math and reading and other tools may then be used in the horizontal application of these structures to the knowledge of the world. (17)

* * * *

There are some other areas of knowledge which may be part of thinking, and may follow a developmental sequence. If so, they have the same primacy as the cognitive and social-moral which this system has outlined. Among these are psycho-motor development, emotional development, perceptual development, and the development of memory. Some work has been done in these areas to discover the sequences of natural development, examine the possible structural nature of them, and find ways to assess individual development. They should be included in this system when the relevant observations, research, and theory have been completed. Until then they should be included in an educational program with the same cautions as other areas. (18)

* * * *

It should be clear from this section of the paper that the teacher and the community are not imposed with an all-encompassing "system" of education when a cognitive-developmental approach to evaluation is used. Rather, the freedom to choose and experiment with curricular content, subject areas, teaching styles, pedagogical traditions, discipline methods, etc., is considerable. In fact, this experimentation and freedom of choice is probably necessary for the cognitive development of the teacher himself. Because the thinking structures as described by Piaget and Kohlberg are those which have been found to be universal to human beings, and because

the general processes of interaction which lead to their development are universal to life, they form a "core" of objectives which may be agreed upon as common to all communities and circumstances. (19) But left open are the style, the personality, the content, and the interests of the educators, parents, and children.

V. The Use of Evaluation Information

It should be clear that this system is focused on formative evaluation, evaluation which helps the educator define what he should do next, as well as telling him how he has done in the past. It provides him with a standard by which to judge student performance and classroom process which is not dependent on how well others have done or on the whims of an "authority". It allows him to keep track of the growth of each child without reducing him to a point on a normal curve or dividing him up into skill area statistics. (20)

The information gleaned from student performance on the tasks in this system should give the educator an understanding of the way the child sees the world. It will allow him to discover the nature of the child's thinking processes and the way a child explains things to himself. This increase in teacher understanding may then be used to better structure the school experience to fit the growth needs of the child.

Curriculum design is enhanced by the evaluation information. It is subjected to an overall framework through the developmental approach. Presentations may be made clearer, or activities planned to be more challenging, if the children's ways of knowing are understood.

Also, "blank areas" of horizontal application may be discovered which can then be worked into the curriculum. Each activity can have as a guide the exercise or challenge of specific thinking structures in a certain area (though the activities should not be restricted to "teaching" only those specific areas).

Because of the clear sequential nature of growth that is being measured, intervention and individual special education or remedial

help is given a purpose and a structure. Growth abnormally retarded at a lower stage may be exercised and challenged in specific ways to bring it to the next stage. (21)

Evaluation information may also be used in summative ways. The effectiveness of a particualr program or set of activities may be assessed, providing the time period is sufficiently long to measure growth in basic structures. Its results may then be compared with those of competing programs evaluated by the same system, using appropriate experimental or quasi-experimental research designs. This will be discussed further in the section following on research possibilities.

VI. Research Possibilities

The cognitive-developmental approach to ecucation is in its early pre-operational stage at this time. Careful and serious research and experimentation is necessary for its proper translation into educational practice. Laboratory-type experimentation has established some basic principles and outlined the nature of growing structures and the process of change. Comprehensive, operational experiments and quasi-experiments must now go beyond the laboratory and the interview, and be carried out in classrooms and educational programs. Besided specific curriculum projects, such as moral development filmstrips or math programs (22), the theory should be applied to the classroom or school as a whole, to the everyday processes of teaching and learning in all areas and subjects. It is from this kind of experiment that "Education for Development" may be truly assessed as an educational and philosophical ideology.

Some specific areas of relevant research are already in progress. Pinard and Vinh-Bang are working on scales of development and standard-form tests to assess individual development in Piagetian terms. (23) Kohlberg is standardizing the interview and scoring procedures for his moral development tasks. In the process, normative data is being collected over a wide range of ages, classes,

and cultures. This type of research must continue so that a complete scale of sequential development may be defined in relevant areas, and scalogram Guttman-type analysis be made to help determine the nature of the truly "structural-developmental" areas.

The areas of psycho-motor, emotional, perceptual, and memory development should be subject to the same analysis, and the processes necessary for growth in these areas be made clear.

Most important, and least evident, is research on the relation of various educational atmospheres or environments to cognitive development. What general and specific processes ineveryday school life are necessary for optimal development? Is there a model classroom which allows the most development? In Appendix F, a research strategy is proposed which uses the Classroom Process Objectives rating scale and certain developmental tasks to explore the relationship between classroom process and cognitive development, and to test some theoretical explanations of developmental change. This strategy and other research designs, call for experimental classrooms and complete programs based on the theory.

VII. Conclusions

Cognitive-developmental psychology will not answer all questionas about education, dictate a solution to every problem, or provide direction in every situation. It can only rpovide a general framework for the process of education. It can outline a valid aim for education which has common acceptance and philosophic credibility, at a time when conflict between specific ends ands goals is serious. It can suggest means and processes which are not strictly instrumental or relative, but are based on universal human functions of organization and adaptation.

Here has been outlined the application of the theory to educational evaluation. The concern with accountability and competency-based teacher evaluation, so evident in current educational debates, may be partly caused by an inability to agree on the things that are to be measured in education. Cognitive-developmental theory provides

a basis for making the decision as to what should be measured, one which may be agreeable to all the parties involved.

It has also been suggested how the theory may serve as a general framework for the design of curriculum and classroom processes, as well as a system of student and program evaluation. If development is to be the aim of education, the theory must be applied and tested in all aspects of the schooling process. Its use in an evaluation system is only a beginning.

Notes

1. Piaget's work has been compiled most completely by John Flavell in The Developmental Psychology of Jean Piaget. Besides Piaget's books, the research is represented by the works of Barbel Inhelder, Hans Furth, J. McV. Hunt, Lawrence Kohlberg, and Adrien Pinard, all listed in the Bibliography. Piaget's stages of growth are outlined in Appendix A.

2. The precise requirements of true developmental structures or stages have been defined by Piaget in Tanner &Inhelder (1960), pp. 13-15, and by Kohlberg in "Stage and Sequence", and in Flavell, pp. 19ff. They are
   - -Qualitative differences in modes of thinking.
   - -Form an invariant sequence which is universal and irreversible.
   - -Act as widely applicable "structured wholes".
   - -Form hierarchy of increasing integration and differentiation.

3. Kohlberg's stages of moral development are outlined in Appendix A. Piaget's notions of developmental change, his idea of equilibration, is explained in Flavell, pp. 244ff., and by Piaget in chapter 4 of Six Psychological Studies. The process of change in moral development has been outlined by Kohlberg in "Stage and Sequence", and studied in Turiel's work. This equilibration model of stage-change continues to be the subject of much research.

4. The best available summaries are Flavell's The Developmental Psychology of Jean Piaget (of his complete work), or Ginsburg and Opper's Piaget's Theory of Intellectual Development, or Piaget and Inhelder, The Psychology of the Child.

5. These are the "experimental" books: Judgement and Reasoning in the Child, The Child's Conception of the World, The Child's Conception of Physical Causality, The Origins of Intelligence in Children, The Construction of Reality in the Child, The Child's Conception of Number, The Child's Conception of Time, The Child's Conception of Movement and Speed, The Child's Conception of Space, The Child's Conception of Geometry, The Growth of Logical Thinking, and the Early Growth of Logic in the Child. These studies are summarized in Flavell, pp. 298-357.

6. Most of Kohlberg's works listed in the bibliography describe these stages in his system. The most comprehensive statement is "Stage and Sequence: The Cognitive-Developmental Approach to Socialization". The relationship of cognitive and moral stages (that certain cognitive stages are necessary but not sufficient conditions for the attainment of certain moral stages) is charted in Kohlberg's "The Concepts of Developmental Psychology as the Central Guide to Education", pp. 44ff; an in the Colby, Fritz and Kohlberg study.

7. A discussion of the horizontal décalage phenomenon and its relation to educational objectives is in Kohlberg's "Central Guide" paper (see note 6) pp. 33-34.

8. See note 5.

9. Vinh-Bang, Elaboration d'une echelle de developpement du raisonnement; and Pinard, "IQ and Point of View" and article in Athey and Rubadeau volume.

10. Inferring mental structure from performance on these task s requires knowledge of developmental stages and children's reasoning structures. Reading the original experimentalbooks of Piaget will give complete information on the methode clinique; Inhelder's The Diagnosis of Reasoning in the Mentally Retarded has an appendix which explains the general method to be followed. It is important to recognize that the "right answer" on a task is not evidence of structure: the interviewer must know what questions to ask to probe the nature of the child's reasoning. Other tasks are listed in Furth's Inventory of Piaget's Developmental Tasks and in Fogelman's Piagetian Tasks for the Primary School. Moral dilemmas and their scoring are explained in Kohlberg's Interview Manual.

11. Because this evaluation system is criterion-referenced, each child's performance should be compared with his previous performance, and not so much with the performance of his age-mates. Rates of development vary widely among individuals.

12. The sources of these "functional invariants" in Piaget are biological. See Flavell, pp. 44-52, or Piaget's Biology and Knowledge or The Origins of Intelligence in Children.

13. Research on the mechanisms of stage-growth is hotly debated and ongoing. Piaget's theory of equilibration (see note 3) is important here; so are the training experiments of Inhelder and Sinclair, Turiel, and Langer in Mussen et. al. Trends and Issues in Developmental Psychology, which tend to show that structural change cannot be forced, and that associationist theories of leraning do not apply to the learning of logical structures. On this last point, see the papers by Engelman and Kamii in Flamer et.al. Measurement and Piaget.

14. See Furth, Thinking Without Language.

15. Piaget considers the verbal interchange between children to be very important for the growth of intelligence. See sections IIIA and IVC of the Process Objectives outline in Appendix F.

16. That thinking preceded language in children's development is the subject of Piaget's Language and Thought of the Child. The notion of reading and math as tools for thinking is evident in Furth and Wachs' Thinking Goes to School.

17. See the training studies in note 13, especially Inhelder and Sinclair's comments about the role of language training in structural development, and the transferability of structures from one field to another.

18. See Piaget's The Mechanisms of Perception and Furth and Wachs' Thinking Goes to School for a cognitive-developmental approach to perceptual and psycho-motor areas.

19. See Kohlberg's "Stage and Sequence" for evidence on the universality of stages. See Skager and Broadbent's "Cognitive Structures and Educational Evaluation" for a discussion of how a Piagetian approach may be agreed upon as the source of a common core of knowledge.

20. An explanation of how the cognitive-developmental approach differs from other educational ideologies and of its philosophical bases is in Kohlberg and Mayer's "Development as the Aim of Education" and in Kohlberg's "The Concepts of Developmental Psychology as the Central Guide to Education". That this evaluation system is not norm-referenced or based on comparative IQ or achievement testing should be always kept in mind (see Elkind, "Piagetian and Psychometric Approaches to Intelligence".)

21. See Inhelder's The Diagnosis of Reasoning in the Mentally Retarded, and Selman's paperon the "Stages of Role-Taking and Moral Judgement as Guides to Social Intervention", and Furth and Wachs' Thinking Goes to School.

22. Piagetian theory and research has been used to design school curricula in specific areas, which are published and sold as packages by publishing companies. Dienes and Golding have used the theory in elementary math programs; Kohlberg and Selman have developed moral education programs with filmstrips and discussions. Complete pre-school programs based on Piagetian theory have been designed and implemented by Kamii, Lavatelli, Weikart et.al., and others (see bibliography).

23. See note 9.

Appendix A: Summaries of Piaget's stages of cognitive growth and Kohl berg's stages of moral reasoning and Appendix B, continued: Some Additional Piagetian Tasks -- Changing Criteria and Class Inclusion -- have been removed to conform with copyright laws.

Appendix B:

Develcpmental Assessment Tasks

The description and administration of Piagetian tasks is rather simple and straightforward. Many authors have reported on the results of such tasks given to various populations, and some quote age-norms for passing and failing (see Fogelman, Piagetian Tests for the Primary School for a summary of these reports). Furth has collected a wide range of the most useful tasks into a paper-and-pencil booklet form. Pinard is standardizing the administration and scoring of about 25 Piaget tasks to be used in an IQ-substitute battery. And probably everyone who reads this has poured water in front of a six-year-old to test his conservation of liquid concept.

If we are to accurately assess cognitive structure, however, we must go beyond the administration and observation of these tasks. The behavior or performance of children on the tasks must be related to the "core" structures of thinking which are the criteria in this evaluation system. We must have a clear line of inference leading from the child's words or actions on a particular task to the structures which are the general patterns of his thinking. The passing of this or that Piagetian task is not the aim of this education nor is it the measure of growth. The purpose of the tasks is to enable us to catch a glimpse of the growing mental structure of the child.

So far I have completed two tasks in terms of this behavior/structure analysis. They are included here in a form which allows for a semi-standardized administration and a means of relating the child's performance to his mental operations and structural stage. Included are sample questions, instructions, and a chart which specifies some of the relations between performance, operations, and stages. The Balance task and the Clay Balls task have been adapted from Piaget and Inhelder. Through pilot-testing I have determined the form in which they are presented here to be the most adequate for the purposes of this system.

Other Piagetian tasks may be so analysed and formulated to be included in this appendix. Tasks to assess moral reason-

·ing structure and role-taking ability, such as Kohlberg's moral dilemmas and Selman's stories, may be slightly adapted to fit this formula, but they are sufficiently structured already to be used directly. The more facets of structure we can explore, the more complete will be our evaluation of the child's mental processes.

Task: Clay Balls

Area: Conservation of substance, weight, and volume

Equipment: Two plasticene balls of equal size.
Balance for weighing.
Two glasses half full of water.
A steel or lead ball the same size as the clay balls.
A steel or lead ball the same weight as the clay balls.

Behavior/Performance	Sample Questions	Concept (Operations)	Stage	
Says there is more/less clay when shape* is changed.	1,2,3	Non-conservation of substance.	I	Pre-Operational
Says amount of clay is the same when shape is changed.	1,2,3	Conservation of substance (Identity; Compensation)	IIA	Concrete Operational
Says weight of clay is the same when shape is changed.	4	Conservation of weight	IIB	
Says amount of displaced water is the same when shape is changed.	5,6,7	Conservation of volume	III	Formal Operational

Sample Questions: (begin with two identical balls)

1. (change one into a sausage) Now which one has the most clay, or are they both the same? Why?

2, (change one into a pancake) Now which one has the most clay, or are they both the same? Why?

3. (break one into pieces) Now which one has more clay, or are they both the same? Why?

4. (verify equal weight of balls)
(change one into a sausage)
pancake) Now which one will weigh more, or will they
pieces) weigh the same? Why?

5. (put each in glass of water. Note change in water level)
(change one into a sausage)
pancake) Now will the water level be higher, lower,
pieces) or the same? Why?

6. (substitute same-size lead ball for one) Will the water level be higher, lower, or the same? Why?

7. (substitute same weight lead ball for one. Verify weight.)
Will the water level be higher, lower, or the same?
Why?

Task adapted from Inhelder, The Diagnosis of Reasoning..., 1968
* "shape" change includes breaking into pieces.

Task: Balance

Area: Logical Relations

Equipment: "Invicta Mathematical Balance" (available from Selective Educational Equipt. Co., Newton, Ma.)
Varying weights which may be hanged on balance.

Behavior/Performance	Sample Questions	Operations	Stage	
Knows that weight has effect.	1	Self/apparatus distinct.	IA	Pre-Operational
Can balance it by symmetry.	2,3	Perceptual corresp.	IB	
Can add or subtract weights to make it balance. Can add or subtract distances to make it balance.	4 5	Reversible addition and subtraction.	IIA	Concrete Operational
Can compensate weight by distance, & vice-versa. (additive)	6	Inverse correspondence. $W_1 < W_2 < W_3$; $L_1 > L_2 > L_3$	IIB	
Proportional compensation of weight & distance.	7	Inverse proportion. $\frac{W_1}{W_2} = \frac{L_2}{L_1}$	IIIA	Formal Operational
Relates distance & weight to vertical travel of weight.	8	Double inverse proportion. $\frac{W_1}{W_2} \simeq \frac{L_2}{L_1} = \frac{H_2}{H_1}$	IIIB	

Sample Questions:

1. (put ① on 10) What will happen if I put this here? Why?
2. (put ① on 10 & give ①) Where should you put this to make it balance? Why?
3. (put ① on 6 & give ①) Where should you put this to make it balance? Why?
   (put ① on 2' & give ①) " " " " " " " " " " ?
   (put ① on 9 & give ①) " " " " " " " " " " ?
4. (put ① on 3, ① on 2, ① on 2' & give ①) Where should you put this to make it balance? Why?
5. (put ② on 5, ① on 10) Switch the sides the weights are on and make it balance.
6. (put ② On 2 & give ①) Where should you put this to make it balance? Why?
   (put ① on 8, ② on 4') Why does this balance?

Sample Questions (cont'd.):

7. (put ① on 10, ① on 3, ① on 8' & give ①) Where should you put this to make it balance? Why?

8. Why does it weigh more (or have more pull, etc.) at farther distances?

Explanatory key:

W means weight in general. W_1, W_2, etc. are specific weights.

L means distance in general. L_1, L_2, etc., are specific distances.(from ctr.)

① in a circle is a single silver weight (supplied with the balance).

② in a circle is a double silver weight (two single weights together)

"① on 3" means a single weight on the third peg from the center on the right side.

"① on 3'" means a single weight on the third peg from the center on the left side.

H means vertical distance traveled by weight.

"give ①" means give the subject one weight to put on the balance.

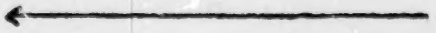
Notes:

Subject should predict where the weight should go, then be allowed to try out his prodiction, then be asked to give explanations or reasons for the results, in each question.

Be sure the subject is familiar with the basic operation of the balance before beginning questioning -- let him play with it, etc.

Experimentor should challenge the reasons given by the subject, even if his reasons are correct.

Task adapted from Piaget & Inhelder, The Growth of Logical Thinking from Childhood to Adolescence, 1958; and Robert Selman, 1974.

Balance: IA									P
Balance: IB									P
Balance: IIA									P
Balance: IIB									P
Balance: IIIA									P
Balance: IIIB									P
Conservation of subst.IIA	-	16	16	32	72	84	-	-	I
Conservation of weightIIB	-	0	12	24	52	72	76	96	I
Consv. of volume IIIA	-	0	0	12	28	32	56	80	I
Consv. of number	8	50	75	80	-	-	-	-	I
Consv. discont. quantity	-	22	54	96	-	-	-	-	I
Consv. liquid	-	4	18	74	-	-	-	-	I
Consv. length	-	8	4	20	68	96	-	-	I
Multiplicative Classifica.	0	0	-	50	-	90	-	-	F
Additive Classification	0	0	-	-	50	50	-	90	F
Seriation	0	-	-	50	-	90	-	-	F
Transitivity of Length	0	-	-	-	50	-	90	-	F
Class Inclusion	0	0	-	-	50	-	90	-	F

Sources: P= Piaget & Inhelder, The Growth of Logical Thinking
I= Inhelder, The Diagnosis of Reasoning in the Mentally Retarded
F= Fogelman, Piagetian Tests for the Primary School

Appendix D: Normative Data for Some Piaget Tasks

00026

Education for Development:

Classroom Process Objectives

This observation instrument is part of a system for assessing the effectiveness of an educational program. This system is based on the assumption that cognitive and social development is the general aim of education, and that the progress of each individual through a sequence of development is a goal of the educational program. The definition and description of this universal sequence of development, in both cognitive and affective domains, is evident in the work of Jean Piaget and his followers in the structural-developmental area of psychology.

Other instruments in this system are designed to assess the cognitive and social development of individual children in terms of this sequence. This rating scale is designed to measure the classroom processes which should be effective in promoting development in these terms. It is not meant to outline all of the processes necessary for education. Rather it defines those specific environmental and attitudinal aspects of any classroom which are critical to mental growth in children. In general, it should be applicable to preschool through grade five or six, because it is concerned with processes of teaching and learning rather than with specific curriculum content. The scale is designed to be used by teachers, supervisors, parents, or evaluators, in formal observation sessions or in informal assessment.

The processes necessary for optimal development may be outlined as follows. The items in the scale follow the order of this outline, and the objectives included in each section are indicated.

I. Children interact with the content of the world. (items 1-32)
   A. Engage in problem-solving activities.
   B. Explore and experiment with the environment.
   C. Perform actions with physical objects.

II. Children interact with their peers. (items 33-48)
   A. Talk and listen to each other.
   B. Cooperate with groups in their activities.

III. Children experience "cognitive conflict". (items 49-61)
   A. Are challenged in their thinking.
   B. Are aware of alternative methods of thinking.
   C. Discuss these methods with others.

IV. Teacher uses knowledge of developmental levels. (items 62-74)
   A. Teacher is aware of the children's thinking structures.
   B. Activities are geared to the child's level.

V. Children are motivated by the activities themselves (items 75-81)

Each area of the outline and its objectives have been derived from cognitive-developmental theory and research. The objectives are expressed in readily observable, low-inference terms, to be scored 1 (no evidence), 2 (slight evidence), 3 (moderate evidence), 4 (extensive evidence), or X (cannot make judgement), according to their occurence in the classroom. Some items are intentionally inconsistent with the theory, such that a 1 on these items would be a favorable score. Specific scoring instructions are on the last page. A classroom or program which scores highly on this scale should lead to more effective development by its students.

	no evidence	slight evidence	moderate evidence	extensive evidence	cannot make judgement
1. Children work directly with materials.	1	2	3	4	X
2. Children explore and experiment freely.	1	2	3	4	X
3. Books are supplied in diversity and profusion.	1	2	3	4	X
4. Children are involved in a variety of problem-solving experiences.	1	2	3	4	X
5. Materials are supplied in great diversity with little replication.	1	2	3	4	X
6. Children utilize many resources to solve problems.	1	2	3	4	X
7. Teacher supports problem-solving behavior.	1	2	3	4	X
8. Children interact with materials which guide and direct the activity.	1	2	3	4	X
9. Teacher tells children in advance what to expect from an activity.	1	2	3	4	X
10. Children use and investigate everyday things in many ways.	1	2	3	4	X
11. Teacher makes sure children use materials only as instructed.	1	2	3	4	X
12. Teacher uses play as an opportunity for learning.	1	2	3	4	X
13. Children use their own methods to solve problems in classroom activities.	1	2	3	4	X
14. Children read stories created by their peers.	1	2	3	4	X
15. Materials are readily accessible to children.	1	2	3	4	X
16. Books are the primary media of instruction.	1	2	3	4	X
17. Children explore materials designed to teach specific concepts.	1	2	3	4	X

	no evidence	slight evidence	moderate evidence	extensive evidence	CAnnot make judgement
18. A distinction is clearly made between "work" time and "play" time.	1	2	3	4	X
19. Children passively listen to teacher.	1	2	3	4	X
20. Children are engaged in drill and practice activities.	1	2	3	4	X
21. There are many "real world" things in the classroom.	1	2	3	4	X
22. Children use natural materials in their activities.	1	2	3	4	X
23. Environment includes materials developed or supplied by children.	1	2	3	4	X
24. Children persist at their activities to completion.	1	2	3	4	X
25. Children are deeply involved in what they are doing.	1	2	3	4	X
26. Children experiment with materials and observe the results.	1	2	3	4	X
27. Teacher asks experience-based questions of children as they are engaged in activity.	1	2	3	4	X
28. Teacher allows children to discover relationships and principles in their activity.	1	2	3	4	X
29. Teaching is based on each individual child and his interaction with materials and equipment.	1	2	3	4	X
30. All materials are specially designed and used only to teach specific concepts.	1	2	3	4	X
31. Materials are kept out of the way until they are distributed or used under the teacher's direction.	1	2	3	4	X
32. Children fidget with materials without active engagement.	1	2	3	4	X

	no evidence	slight evidence	moderate evidence	extensive evidence	cannot make judgement
33. Teacher prefers that children not talk when they are supposed to be working.	1	2	3	4	X
34. Teacher encourages children to express their ideas in words.	1	2	3	4	X
35. Children seek out and use constructive criticism of their work.	1	2	3	4	X
36. Children are distracted by others.	1	2	3	4	X
37. Children seek assistance from other children in their activities.	1	2	3	4	X
38. Children are expected to do their own work without getting help from others.	1	2	3	4	X
39. Children work individually and in small groups at various activities.	1	2	3	4	X
40. Children are not supposed to move about the room without asking permission.	1	2	3	4	X
41. Children share materials with others.	1	2	3	4	X
42. Children are engaged in activity and are talking.	1	2	3	4	X
43. Children share ideas with others.	1	2	3	4	X
44. Children are engaged in a cooperative venture with a group.	1	2	3	4	X
45. Children voluntarily group and regroup themselves at various activities.	1	2	3	4	X
46. Children initiate conversations with peers.	1	2	3	4	X
47. Children spontaneously look at and discuss each other's work.	1	2	3	4	X
48. Teacher encourages children to talk among themselves.	1	2	3	4	X
49. Children invent many different solutions to problems.	1	2	3	4	X
50. Teacher helps children to look at things from different viewpoints.	1	2	3	4	X

	no evidence	slight evidence	moderate evidence	extensive evidence	cannot make judgement
51. Students offer alternative solutions to problems they are working on.	1	2	3	4	X
52. Teacher asks challenging questions about the activity a child is engaged in.	1	2	3	4	X
53. Problems with alternative solutions are presented to the group.	1	2	3	4	X
54. Teacher discusses children's questions with the group.	1	2	3	4	X
55. Rules and discipline are discussed freely by children and teacher.	1	2	3	4	X
56. Teacher takes care of conflicts without involving the group.	1	2	3	4	X
57. Teacher approves only correct answers.	1	2	3	4	X
58. Children use teacher-presented methods in working out problems and activities.	1	2	3	4	X
59. Children's ages are distributed over more than three years.	1	2	3	4	X
60. Teacher stresses group acceptance of the correct answer to problems.	1	2	3	4	X
61. Teacher asks divergent questions, with many "right" answers.	1	2	3	4	X
62. Systematic observation of children is made constantly.	1	2	3	4	X
63. Teacher keeps collections of each child's work for use in evaluating his development.	1	2	3	4	X
64. Children work at their own pace as long as they wish.	1	2	3	4	X
65. Teacher keeps notes and histories of each child's progress and development.	1	2	3	4	X
66. Teacher observes children's individual activity to obtain diagnostic information.	1	2	3	4	X

	no evidence	slight evidence	moderate evidence	extensive evidence	cannot make judgement
67. Teacher shows respect for children's thinking.	1	2	3	4	X
68. Teacher uses tests to compare children with their peers.	1	2	3	4	X
69. Materials are appropriate to the age level of the children.	1	2	3	4	X
70. Standardized paper-and-pencil tests are used to measure student progress.	1	2	3	4	X
71. Teacher accepts children's explanations or ways of solving problems.	1	2	3	4	X
72. Children are expected to keep up with the rest of the class in their work.	1	2	3	4	X
73. Teacher's lessons and assignments are given to the class as a whole.	1	2	3	4	X
74. Tests are used to grade students.	1	2	3	4	X
75. Children are involved in experiences which are self-rewarding.	1	2	3	4	X
76. Children do things for the internal satisfaction of doing them.	1	2	3	4	X
77. Children are motivated by teacher reward, punishment, or approval.	1	2	3	4	X
78. Teacher helps children evaluate their own behavior.	1	2	3	4	X
79. Children expect teacher to correct all their work.	1	2	3	4	X
80. Children find their activities satisfying.	1	2	3	4	X
81. Children choose their own activities.	1	2	3	4	X

Scoring Instructions

Some of the items on this scale describe "negative" processes. They should be scored as follows:

On these items, if "1, no evidence" is scored, it should count as 4; if 2 is scored, it should count as 3; if 3 is scored, it should count as 2; and if 4 is scored, it should count as 1.

These items are:

Page 1	Page 2	Page 3	Page 4	Page 5
9,11,16	18,19,20,30, 31,32	33,36,38,40	56,57,58,60	68,70,72,73, 74,77,79.

All other items count as they are circled. After you have changed the counts on the "negative" items, add up the scores.
A score of 324 would be evidence of a perfectly cognitive-developmental classroom according to this instrument. A score of 81 would be the lowest possible. In general, scores below 162 may be evidence of a situation which is restricting development.
Scores should be broken down in terms of the categories on the outline on page one, to better assess the factors which are at work in the classroom. The scores quoted above assume no items were scored X.

- -

This instrument is in a preliminary testing stage at this time. (4/74). Please feel free to make copies of it and adapt it to your needs, and to pass it on to others. In order for it to be properly tested, each use of it should be reported to the author.
If possible, mail the instrument with the scores circled as you observed them (or a copy), a short general description of the classroom(s) it was used in, the total score obtained, and your comments or suggestions.

Name_____ School_____

Address_____ Grade(s)_____

Score(s)_____ _____ _____ _____

Program description:

Comments:

Mail to: James G. Lengel
Social Studies Consultant

Vermont State Department of Education
Montpelier, Vermont 05602

Appendix F
The Making of a Classroom Observation Scale

The objective of this project was to develop an observational instrument which would measure how well a classroom implemented the processes which are considered necessary for cognitive growth. The task was to describe these processes as they have been included in Piagetian theory and verified by subsequent research; to expand the descriptions to readily observable behavioral objectives; and to arrange them into a form which could be used by teachers or evaluators. The objectives, presented in useable form, are evident as Appendix E. This appendix will list some theoretical and experimental sources for each of the processes outlined on the first page of the observation instrument. This list is meant to present only some examples, and is by no means exhaustive.

I. Children interact with the content of the world.

Intelligence in Piaget's scheme grows from the interaction between the organism and its environment. Interaction, of the proper style and type, is necessary for intelligence to develop.

A. Engage in problem-solving activities.

"...each time one prematurely teaches a child something he could have discovered for himself, that child is kept from inventing it and consequently from understanding it completely." (Piaget, "Piaget's Theory" in Carmichael's Manual, p. 715.

"Facilitating the child's movement to the next step of development involves...experiences of conflict in the application of the child's current level of thought to problematic situations." (Kohlberg & Turiel, "Moral Development and Moral Education", p. 416.

"It is the feedback from these actions (in trying to solve a conservation of length problem) themselves that finally results in the acquisition of a structure of a higher order..." (Inhelder and Sinclair, "Learning Cognitive Structures"(1969)

B. Explore and experiment with the environment.

"The development of intellectual operations proceeds from effective action in the fullest sense,...since logic is before all else the expression of the general coordination of actions." (Piaget, Science of Education and the Psychology of the Child, p. 71.

"... by carrying out experiments in the child's presence instead of making the child carry them out, one loses the entire informational and formative value offered by action proper as such." (ibid., p. 36)

"The cognitive and affective structures which education should nourish are natural emergents from the interaction between the child and the environment under conditions where such interaction is allowed or fostered." (Kohlberg, "Early Education", p. 1015)

"...the worst performance (on a learning task) is found when the child is not permitted to engage in or observe overt activity....Performance is significantly better when the child is either allowed active manipulation (or) visual access. Finally, retention- particularly long term- is best when the child can both actively manipulate the toys and observe the effects of his activity." (Wolff, et.al. "Activity and Children's Learning", 1974, p. 223)

C. Perform actions with physical objects.

Physical experience: "A second fundamental factor is the role of exercise and of acquired experience in the actions performed on objects....an essential and necessary factor...in the formation of the logico-mathematical structures." (Piaget &Inhelder, The Psychology of the Child, p. 155)

"The children should be provided with suitable equipment, so that in playing they shall come to assimilate intellectual realities which would otherwise remain outside the...intelligence." (Piaget, Science of Education..., p. 157)

II. Children interact with their peers.

"The third fundamental factor",in Piaget's scheme of mental development, "is social interaction and transmission." (Piaget, and Inhelder, The Psychology of the Child, p. 156)

A. Talk and listen to each other.

"This general coordination of the actions necessarily includes a social dimension, since the inter-individual coordination of actions and their intra-individual coordination constitute a single and identical process..." (Piaget, Science of Education..., p. 71)

"Let us therefore try to create in the school a place where individual experimentation and reflection carried out in common come to each other's aid and balance one another." (Piaget, The Moral Judgment of the Child, p. 404)

B. Cooperate with groups in their activities.

"Cooperation is promoted to the rank of a factor essential to intellectual progress." (Piaget, Moral Judgment, p. 405)

"...the more the social stimulation, the faster the rate of moral development." (Kohlberg,"Stage and Sequence", p. 402)

(Cooperation with peers is necessary for the movement out of cognitive "egocentrism" in Piaget's scheme; it forces the child to take the point of view of another in explaining the world. See The Psychology of the Child, pp. 120-122)

III. Children experience "cognitive conflict".

This is Piaget's equilibration theory applied to the classroom. Each of his stages represents a state of equilibrium between the person and his environment. Before movement to a higher state of equilibrium can take place, the current state must be found by the child to be inadequate in dealing with the world. The presentation of conflicts to his cognitive structures should be a classroom process.

A. Are challenged in their thinking.

"Facilitating the child's movement to the next step of development involves (1) exposure to the next higher level of thought and (2) experiences of conflict in the application of the child's current level of thought to problematic situations." (Kohlberg & Turiel, "Moral Development and Moral Education", p. 416)

"...some moderate or optimal degree of discrepancy as constituting the most effective experience for structural change in the organism." (Kohlberg, "Early Education...", p. 1024)

Stage growth and cognitive conflict:"thinking is stimulated by cognitive conflict" (Kohlberg,& Mayer, "Development as Aim", pp. 454ff.)

"... the internal organization must be in disequilibrium for the child to perform any adaptive mental action and, therefore, for change to take place." (Langer, "Disequilibrium as a Source of Development", p. 36)

B. Are aware of alternative methods of thinking.

In an experiment where subjects were exposed to stages of moral thinking other than their own: "...the most successful condition was the +1 exposure. Subjects exposed to the stage directly above their own showed a significant use of that stage (on the posttest)." (Turiel,"Developmental processes in the child's moral thinking", p. 102)

C. Discuss these methods with others.

"Exposure to others more mature than ourselves helps stimulate maturity in our own value processes." (Kohlberg & Turiel, "Moral Development and Moral Education", p.452)

After classroom moral discussions were conducted in a study by Blatt & Kohlberg: "...all children were exposed to the same stimuli, i.e., moral judgements at all stages from stage 2 to stage 6, the actual changes in moral judgement which resulted were relative to the child's own stage and were usually to the next stage up..." (p. 50)

IV. Teacher uses knowledge of developmental levels.

The child's way of knowing the world is qualitatively different from the older child's or the adult's way of knowing. Since learning is subject to the assimilatory restraints of the cognitive structure of the child, curricula and activities must be planned to fit in with the children.

A. Teacher is aware of the children's thinking structures. "There must also be a sensitivity to differences in reasoning between the teacher and the child, as well as among different children. In sum, a knowledge of the child's thinking and level of comprehension is necessary in order to know how reasoning presented by others is being understood and assimilated." (Kohlberg, "The Concepts of Developmental Psychology as the central guide to education", pp. 42-43)

In an experiment with moral reasoning stages: "Subjects exposed to the stage directly above their own showed significant use of that stage, exposure to the stage two above had no effect, and exposure to the stage below had significantly less effect..." (Turiel, "Developmental processes...", p. 102)

"Although learning may accelerate development (within certain limits), such acceleration apparently obeys limitative conditions of assimilation....To summarize, learning is subordinate to the laws of development..." (Inhelder & Sinclair, "Learning Cognitive Structures", pp. 19, 21)

"The developmental problem is to determine when the child's internal state of organization is capable of successfully coping with perturbations (conflicts)." (Langer, "Disequilibrium as a source of development", p.36)

B. Activities are geared to the child's level.
See Inhelder & Sinclair and Langer in IV.A. above.

"... the evolution of operativity is malleable only within certain limits imposed by the laws of development." (Inhelder & Sinclair, p. 19)

"In sum, according to the cognitive stage approach, education

stimulates the elaboration and enrichment of the child's current level of thought (horizontal décalage)..." because the proper attainment and use of higher stages is contingent upon the full application of the lower stages. (Kohlberg, "Central Guide", pp.33-34)

V. Children are motivated by the activities themselves.

The growth of intelligence comes from the organism-environment interaction, which is a natural, innate process in all life. It is not dependent, therefore, on external motivations, but on its own "need to function".

School should "appeal to real activity, to spontaneous work based upon personal need and interest." (Piaget, Science of Education..., p.152)

"...perturbations (cognitive conflicts) have greater significance for cognitive development...when they are internally generated and produced by the child himself than when they are externally generated and presented to him." (Langer, "Disequilibrium as the Source of Development", p. 36)

In the Blatt & Kohlberg study of moral development: "Children showing little interest changed very little, while those who showed considerable change experienced the classroom situations as challenging, were actively involved, and participated in disagreements." (Kohlberg & Turiel, "Moral Development and Moral Education", p. 455)

Appendix F

The Making of the Classroom Objectives Scale

Part 2:

Testing the Validity of the Instrument

The most interesting research that is to be done with the rating scale concerns its construct validity. The scale claims to measure the processes necessary for growth in the terms of cognitive-developmental theory. If this claim is valid, we would expect that developmental growth, as measured by cognitive-developmental tasks, would be greater for those children in classrooms which scored high on the scale than for comparable children in low-scoring classrooms. We would expect this difference in measured growth to be due to either (1) the acceleration of natural development by the high-scoring classrooms or (2) the restriction of natural growth by the low-scoring classrooms, or a combination of both factors. The research design proposed here will serve to test how well this instrument fits into the theoretical system it claims to represent, and/or how well the theory has defined the processes and mechanisms of growth.

We propose a "naturalistic variations" design as the best feasible means to test the instrument. The best design, we realize, would be a truly experimental one: using the objectives in the rating scale to design and implement several classrooms, half of them to be as high-scoring as possible and half as low scoring as possible. Children and teachers would then be randomly assigned to classrooms. Children would be pre- and post-tested on developmental tasks in all areas, and classrooms would be periodically checked to assess the proper implementation of the design.

Since this kind of in vitro experimentation is almost impossible to conduct in this country today, we must settle for the naturalistic variations design. The results of this quasi-experimental research will not have the internal or external validity of a true experiment, but with enough replications it should serve to adequately test the basic hypothesis.

Data Collection

After the Classroom Process Objectives rating scale has

been pilot-tested to establish its reliability (inter-rater, stability), and its problem items changed or removed, the study could begin. Generally, a number of early elementary classrooms will be found where the study may take place. This number will depend on the personnel and cooperation available, the more classrooms the better. In September of the school year, a random sample of children in the classrooms (or all the children if that is possible) will be pre-tested on several developmental tasks. Tasks will be designed or selected to assess cognitive structure in as many areas as possible, at least one task each in the areas of classification, conservation, seriation, moral reasoning, and role-taking ability. Pretest scores will be recorded in terms of the qualitative stage or substage evidenced by each child in eash task.

Meanwhile, the classrooms will be observed and rated according to the scale, preferably by someone who is not involved in testing the children. Periodic visits will be made to each classroom throughout the year, and the score on the rating scale recorded at each visit. Classrooms which show a wide variation in score throughout the year will be dropped from the main sample to be the subject of later special analysis. By the end of the school year, the stable classrooms should each have an average of scores from the various administrations of the observation instrument with little deviation.

Sample children will then be post-tested with the same tasks at the end of the school year, and their stages or sustages in each task recorded.

Analysis of Data

Classrooms will be ranked in terms of their average score on the rating scale on a continuum from "most developmental" to "least developmental". Individual children's scores will be recorded as stage or substage changes in each task, i.e., Conservation= +1, Seriation= -2, Moral reasoning= 0, etc., and as a total score representing the algebraic sum of the task scores.

Data may be compared in several ways. Children's scores

in each classroom may be added up by task or total change score. The classrooms may then be ranked as to their total amount of student change. This ranking of classrooms may then be compared with their ranking on the process observation score. A close fit between the rankings would support the hypothesis that higher-scoring classrooms evidence the most developmental change in children.

Another method of data analysis would be to take the highest-scoring 20% of classrooms and the lowest-scoring 20%, and compare the total change scores of the children in each of these groups. Our hypothesis would expect more positive change in the top 20% than in the bottom 20%.

Also, individual children could be ranked on the basis of their change scores, from most change to least change, and their ranks compared with the rankings of their classrooms. This would help to determine the amount of variance attributable to the classroom as opposed to inter-individual variance. A considerable amount of classroom-explained variance would support the hypothesis.

Besides total change scores, task scores may be compared in each case above. Scores on the separate areas of the process scale may also be used in comparison, to assess their relationships with the various tasks.

Discussion

Although this design does not guarantee that all variance in measured change is due to the classroom atmospheres as measured by our instrument, it can serve to lend support or non-support to our hypothesis, provided the evidence is strong and replicated across many classrooms. It also serves to take care of the following threats to validity common to educational "treatment" studies:

1) Maturation: since pre- to post-test periods were identical for all students, the effects of natural growth are controlled for.

2) Testing effects: since everyone had the same tests, the effects of pre-testing on post-test scores will be distributed equally among high and low-scorers. That testing alone

may help spur developmental change must be kept in mind, however, when the results are to be generalized to other situations.

3) Hawthorne effects: should be identical for all classrooms involved, and much less than if it had been a true experiment.

4) Teaching for the test: the process objectives that constitute the "treatment" in this study are not at all related to the testing tasks used.

The following threats to validity, however, must be kept in mind:

1) History: measured changes may be due to the point in development the children were at when the year began (some may have been on the brink of stage change).

2) Instrumentation: the tests or testers may not be truly measuring the developmental structures unless they interpret the task performance correctly.

3) Selection: a certain kind of teacher or child may naturally end up in a more- or less-developmental classroom, due to their personal styles or other status.

This study may be done at several levels, with a few classrooms or with hundreds, with a complement of five developmental tasks or twenty-five, with all children in all classrooms or with a representative sample. The only intrusions into the educational process would be the two testing sessions and the periodic observations. In testing the construct validity of this particular instrument, we will also be testing some of the basic tenets of cognitive-developmental theory.

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